# Operating Instructions

## DSGH®

### Radiation-Based Detector with GEN2000® Electronics for Density Measurement

Document ID:
31392

Nuclear

# Revision history

| Version | Description | Date |
|---|---|---|
| 1.0 | Initial release. Formerly 245638-EN. | 051201 |
| 1.1 | Changed CD part number 32700, Corrected copyright and registered symbols and date | 061201 |
| 1.2 | Electronics revision | 090306 |
| 1.3 | Added certification information and IECex label | 090814 |
| 1.4 | Changed logo, company name, and website | 110301 |

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**Warning: To ensure CE compliance, use this equipment only in the manner that this manual describes, per VEGA specifications. Otherwise, damage to the unit or personal injury may result.**

# NOTES

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# PREFACE

## Explanation of symbols

| | |
|---|---|
| **In the manual** | |
| | **Radiation notice**<br>Introduces information concerning radioactive materials or radiation safety. |
| | **Caution**<br>Introduces warnings concerning potential damage to the equipment or bodily harm. |
| **On the instrument** | |
| | **AC current or voltage**<br>A terminal to which or from which an alternating (sine wave) current or voltage may be applied or supplied. |
| | **DC current or voltage**<br>A terminal to which or from which a direct current voltage may be applied or supplied. |
| | **Potentially hazardous voltages**<br>A terminal on which potentially hazardous voltage exists. |
| | **Protective ground terminal**<br>Identifies location of terminal intended for connection to an external conductor. |

# Your comments

Manual: DSGH Installation and Operation Guide

Date: _____

Customer Order Number: _____

Your contact information (optional):

Name: _____

Title: _____

Company: _____

Address: _____

_____

_____

_____

Did you find errors in this manual? If so, specify the error and page number.

_____

_____

_____

Did you find this manual understandable, usable, and well organized? Please make suggestions for improvement.

_____

_____

_____

Was information you needed or would find helpful not in this manual? Please specify.

_____

_____

_____

Please send your comments to:

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Director of Engineering
4241 Allendorf Drive
Cincinnati, OH 45209-1599 USA
Fax: +1 513-272-0133

CHAPTER

# 1

# INTRODUCTION

## Nuclear materials notice

This equipment contains radioactive source material that emits gamma radiation. Gamma radiation is a form of high-energy electromagnetic radiation. In many cases, only persons with a specific license from the U.S. NRC or other nuclear regulatory body may perform the following to the source holder:

- Dismantle
- Install
- Maintain
- Relocate
- Repair
- Test

VEGA Field Service engineers have the specific license to install and commission nuclear gauges, and can instruct you to safely operate your gauge. See page 1-11 for contact information.

**Note:** See the Radiation Safety for U.S. General and Specific Licensees, Canadian and International Users Manual that came with the source holder and the appropriate current regulations for details.

## Unpacking the equipment

***Caution:*** *You must be familiar with radiation safety practices in accordance with your U.S. Agreement State, U.S. NRC, or other nuclear regulatory body before unpacking the equipment.*

☑ Unpack the unit in a clean, dry area.

- ☑ Inspect the shipment for completeness. Check against the packing slip.
- ☑ Inspect the shipment for damage during shipment or storage.
- ☑ If the detector is included as a separate package in the shipment, inspect the assembly for damage that may have occurred during shipment or storage.
- ☑ If there was damage to the unit during shipment, file a claim against the carrier, reporting the damage in detail. Any claims against VEGA for shortages, errors in shipment, etc., must be made within 30 days of receipt of the shipment.
- ☑ If you must return the equipment, see the section Returning equipment for repair to VEGA in the Diagnostics and repair chapter.
- ☑ After unpacking the equipment, inspect each source holder in the shipment to ensure that the operating handle is in the OFF position. If you find the handle in the ON position, place it in the OFF position immediately and secure it. **Note:** This applies to only some source holders.

**Note:** Most source holder models accept a lock. Call VEGA Field Service (see page 1-11 for contact information) for more instructions if:

- The source holder does accept a lock and there is no lock on it.
- The lock is not secured.
- You cannot secure the lock.
- The operating handle does not properly move into the OFF position.

See the Radiation Safety for U.S. General and Specific Licensees, Canadian and International Users Manual that came with the source holder and the appropriate current regulations for details.

# Storing the equipment

## Source holder

If you must store it, do so in a clean, dry area. Be sure its shutter is in the OFF or CLOSED position (if applicable). Check the current local regulations (U.S. NRC, Agreement State, or other) to determine whether this area must have any restrictions.

## Gauge

Avoid storage at temperatures below freezing. Store the gauge indoors in an area that has temperature control between +10 °C ... +35 °C (+50 °F ... +95 °F) and < 50% relative humidity. Store equipment in dry conditions until installation.

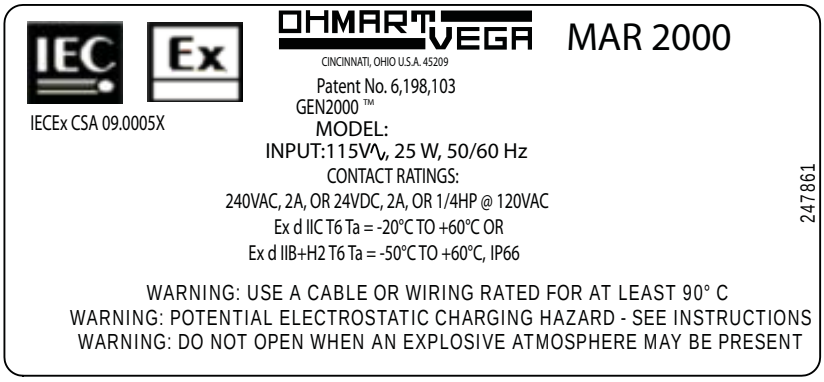
# Certifications

This gauge is designed for certification compliance from the following agencies”

- ATEX Standard
- CCOE (India)
- CEPEL/INMETRO (Brazil)
- CSA
- FM Standard
- GOST-B Standard
- COST-R Standard
- IECex
- JIS (Japan)
- KTL (Korea)
- NEPSI (China)

## Safety Information for EX Areas

Please note the EX-specific safety information for installation and operation in EX areas.


IECEx CSA 09.0005X
OHMART VEGA
CINCINNATI, OHIO U.S.A. 45209
MAR 2000
Patent No. 6,198,103
GEN2000 ™
MODEL:
INPUT:115V~, 25 W, 50/60 Hz
CONTACT RATINGS:
240VAC, 2A, OR 24VDC, 2A, OR 1/4HP @ 120VAC
Ex d IIC T6 Ta = -20°C TO +60°C OR
Ex d IIB+H2 T6 Ta = -50°C TO +60°C, IP66
247861
WARNING: USE A CABLE OR WIRING RATED FOR AT LEAST 90° C
WARNING: POTENTIAL ELECTROSTATIC CHARGING HAZARD - SEE INSTRUCTIONS
WARNING: DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT

IECex Label

# DSGH specifications

**Table 1.1** DSGH specifications

| | | |
|---|---|---|
| System Accuracy | ±1% of span typical | Accuracy depends on specific application parameters |
| Typical Sources | Cesium-137 | 0.66 MeV gamma radiation emitter, 30.2 year half life |
| | Cobalt-60 | 1.2 and 1.3 MeV gamma radiation emitter, 5.3 year half life |
| Power Requirements* | AC | 100 – 230 ±10% VAC (90 – 250 VAC, or with internal heater kit: 115 – 230 VAC) at 50 ... 60 Hz, at 15 VA maximum power consumption (25 VA ≤ with heater) CE compliance requires 100 – 230 ±10% VAC |
| | DC | 20 – 60 VDC (< 100 mV, 1 ... 1,000 Hz ripple) at 15 VA<br>CE compliance requires 24 VDC ± 10% |
| | Wiring | Per local code |
| Signal Cable | Maximum length | 1,000 m (3,280') |
| | HART signal | 1.02 – 0.643 mm (no. 18 or 20 AWG) 2-conductor shielded |
| GEN2000® Electronics Housing | 4-wire hookup with DC | 1.02 – 0.643 mm (no. 18 or 20 AWG) 4-conductor shielded |
| | Certification to CSA and UL standards | • Designed to meet National Electric Code (U.S. and Canada)<br>• Class I, Groups A, B, C and D, Div 1 and 2<br>• Class II, Groups E, F and G, Div 1 and 2 |
| | ATEX Certification | II2 G/D EEx d IIC T6 IP66 -20 °C ... +60 °C (-4 °F ... +140 °F)<br>II2 G EEx d IIB+H2 T6 -50 °C ... +60 °C (-58 °F ... +140 °F) |
| | Enclosure rating | NEMA 4X IP-66 |
| | Ambient temperature | -20 °C ... +50 °C (-4 °F ... +122 °F) option for lower temperatures available |
| | Humidity | 0 – 95%, non-condensing |
| | Vibration | Tested to IEC 68-2-6, IEC 68-2-27, and IEC 68-2-36 |
| | Material | Cast aluminum ASTM A 357 |
| | Paint | Polyester Powder Coating |

**Table 1.1** DSGH specifications (continued)

| | | |
|---|---|---|
| Weight | Housing detector | 5.44 kg (12 lb) |
| Current Loop Output | Rating | 4 mA ... 20 mA, isolated, into 250 – 800 Ω |
| | Power | Jumper selectable: source (active) or sink (passive) mode |
| Relay Output | Software user-settleable | Diagnostic alarm or process high/low alarm function |
| | Rating | 6 A at 240 VAC, or 6 A 24 VDC (SPDT Form C), or 1/4 HP at 120 VAC |
| HART® Communication | HART Protocol | BEL202 FSK standard current loop output |
| | PC interface | HART modem and VEGA communications software |
| | Optional hand-held interface | Emerson Field Communicator model 375 with VEGA device descriptions loaded |
| Auxiliary Input Capability | Type | Frequency input (0 ... 100 kHz) |
| | Possible function | Optional Mass Flow or Temperature compensation, multiple gauge linking, and others |
| Electronics | On-board memory | FLASH and 2 EEPROMs |
| | Real-time clock | Maintains time, date, source decay compensation, and is Y2K compatible |
| Diagnostics | LED indication | +6V, Memory Corruption, HART, CPU Active, Auxiliary, High Voltage, Relay and Field Strength |

* Power specifications change if an internal heater kit is used.

# Typical applications

VEGA's density gauges accurately indicate:

- Density of liquids or slurries through a pipe or vessel wall without contact to the material
- Percent of solids in a carrier
- Interface between liquids flowing in a pipe, when the liquids differ in density

# Principle of operation

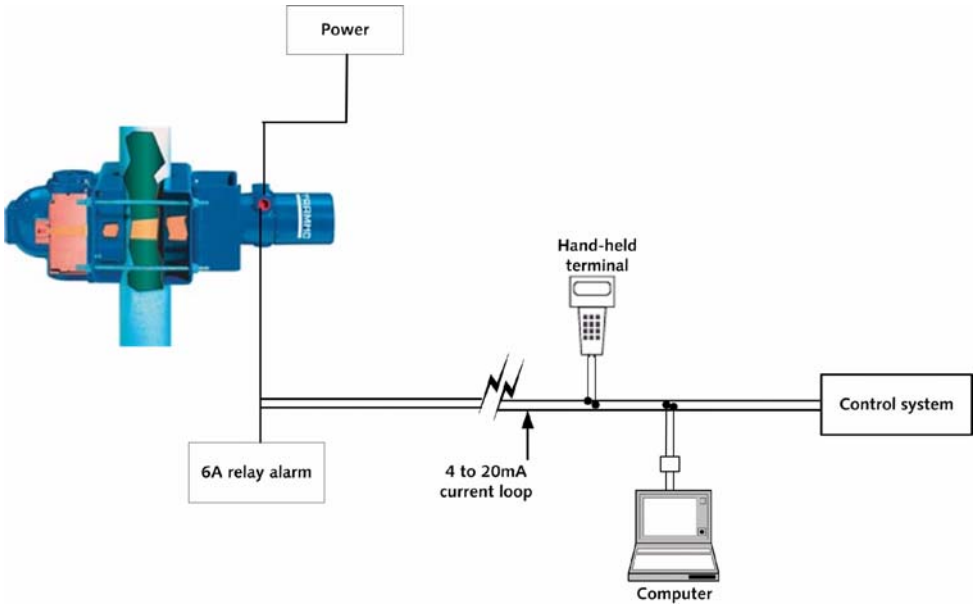
The gauge receives a shaped or collimated beam of radiation from the source holder through the process material. The material in the vessel shields part of the detector from exposure to the radiation field. As the process material mass decreases, the detector senses more radiation, and vice versa.

Calibrating the gauge associates the detector readings (or counts) with the density of the material in engineering units. The output range of the gauge is a 4 mA ... 20 mA current loop signal, in proportion to the density of the process.

# System overview

The gauge uses VEGA's GEN2000®, VEGA's newest compact electronics that support 4 mA ... 20 mA HART® protocol, frequency, or fieldbus output. The density measurement system includes:

- Source holder
- Detector assembly
- Communication device (HART modem with PC and VEGA software or Emerson Field Communicator 375)

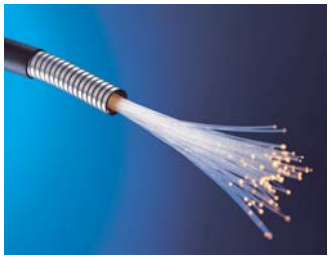


## Source holder

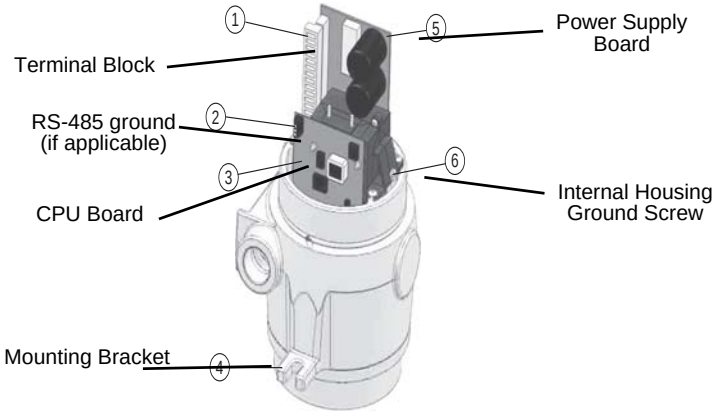
- A cast or welded steel device that houses a radiation-emitting source capsule
- Directs the radiation in a narrow collimated beam through the process vessel
- Shields the radiation elsewhere
- The model chosen for each system depends on the source capsule inside and the radiation specifications
- Its shutter completely shields the radiation (source off) or lets it pass through the process (source on) (if applicable)

## Detector assembly

- Mounts opposite the source holder.
- Inside the detector is a scintillator material, which produces light in proportion to the intensity of its exposure to radiation.



- A photomultiplier tube detects the scintillator's light and converts it into voltage pulses.
- The microprocessor receives these voltage pulses after amplification and conditioning by the photomultiplier tube.
- The microprocessor and associated electronics convert the pulses into an output that can be calibrated.




GEN2000

# Communicating with the gauge

The gauge is a transmitter that produces the current loop signal directly at the measurement site.

Use a field communicator or HART modem and Ohmview 2000 software with a PC to enable:

- Initial setup
- Calibration
- Other communication with the gauge

You can make a connection anywhere along the 4 mA ... 20 mA current-loop line. After setup and calibration of the gauge, there are no everyday requirements for external electronics.

## Using a field communicator

VEGA's gauge is compatible with the Emerson 375 Field Communicator or equivalent.

To function, the minimum load resistance on the 4 mA ... 20 mA loop must be 250 Ω. See the instruction manual for your field communicator for information about:

- Key usage
- Data entry
- Equipment interface

To effectively use the gauge features, you must use VEGA's device description (DD) to program the HART communicator. You can purchase a field communicator, programmed with the DD, through VEGA (VEGA part number 244880).

Use firmware 2000.00 or higher when you use the field communicator to use NORM or vapor compensation.

**Note:** There are some minor differences in operation of the Ohmview 2000 software and the field communicator. Most significantly, Ohmview 2000 software writes entries immediately to the transmitter, but a field communicator must be manually told to sends changes.

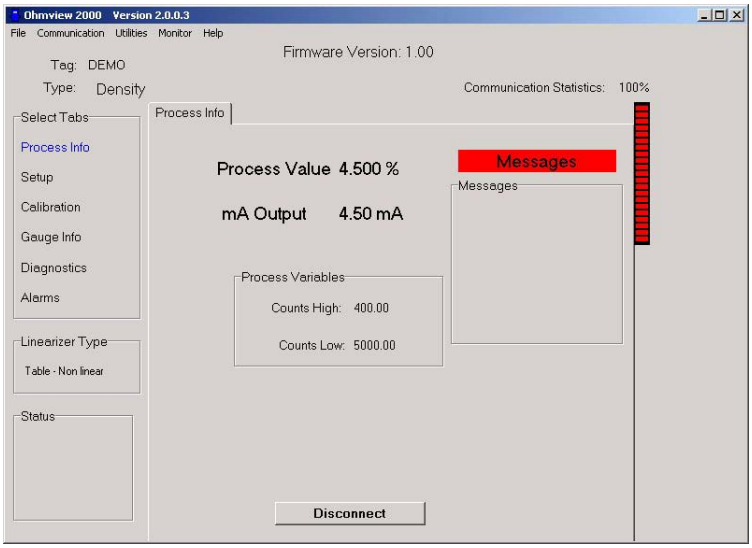
## Using Ohmview 2000 Software on a PC

When you use a PC with MS Windows® and a Pentium® processor to communicate with the gauge or other VEGA HART transmitter field devices, you must have a HART modem and the Ohmview 2000 software kit (part number 243008), which includes:

- Modem
- Cables
- Software

Ohmview 2000, RS-485 Network, Ohmview 2000 Logger, and Ohmview 2000 Configurator software are Windows programs that emulate the Field Communicator Model 375. Ohmview 2000:

- Charts the 4 mA ... 20 mA current output graphically
- Stores and retrieves configuration data to disk
- Enables offline editing of configurations




Example of Ohmview 2000 Software

The Ohmview 2000 Software includes:

- Main Ohmview 2000 software
- HART Communication Server
- Launcher program
- Ohmview 2000 Logger
- Ohmview 2000 File Configurator

- Ohmview 2000 Electronic User Manual

When you insert the CD, the program installs these programs onto your hard drive.

**Note:** The HART Communication Server must always be on when using Ohmview 2000's main program and Ohmview 2000 Logger.

# Customer Service

## U.S. and Canada

On-site field service is available in many locations. Often, a field service engineer is at your plant for your gauge's startup. Field service engineers also provide assistance by phone during office hours.

For emergencies (example: line shut down because of VEGA equipment), you can reach us 24 hours a day.

**Table 1.2** Contact information

| | |
|---|---|
| Tel (Monday – Friday 8:00 A.M. – 5:00 P.M. EST) | +1 513-272-0131 |
| Tel (emergencies: follow the voice mail instructions) | +1 513-272-0131 |
| Fax | +1 513-272-0133 |
| Field service e-mail | fieldservice@vega.com |

## Worldwide

Contact your local VEGA representative for parts, service, and repairs.

## Have this information ready

☑ VEGA Customer Order (C.O.) Number

Located on the source holder's engraved label

☑ Sensor's serial number

Located on the gauge's housing inside the external housing

CHAPTER

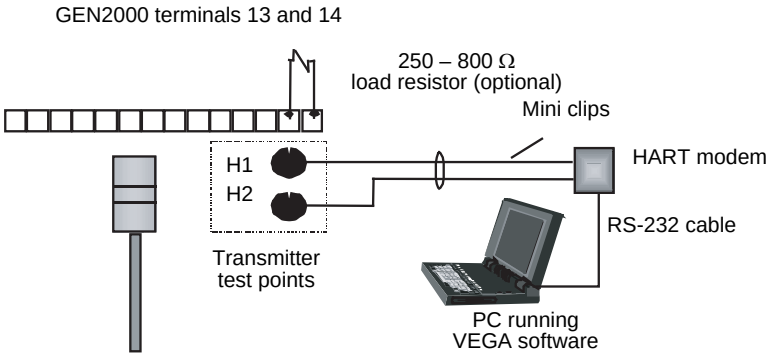
# 2

# INSTALLATION

## Testing on the bench

To ensure a quick start up after installation, you can test the detector assembly with the HART compatible communication device (a field communicator or a PC with a HART modem and VEGA software). Bench testing lets you check:

- Power
- Communication
- Initial setup software parameters
- Some diagnostics




**Bench test setup**

**Note:** You may need to reset the time and date if the gauge has not had power for > 28 days. The Real Time Clock Fail message may appear. You must enter the correct time and date. The clock is the basis for source decay calculations.

You can calibrate the current loop output on the bench before mounting the detector on the process. See page 3-3.

# Location considerations

When you ordered the gauge, VEGA sized the source for optimal performance. Notify VEGA before installing the gauge if its location differs. Satisfactory operation depends on proper location.

**Note:** Locate the source holder where process material cannot coat it. This ensures the continuing proper operation of the source ON/OFF mechanism (if applicable). Many regulatory bodies (example: the U.S. NRC) require periodic testing of the ON/OFF mechanism.

See the Radiation Safety for U.S. General and Specific Licensees, Canadian and International Users Manual and the Radiation Safety Manual Addendum of Reference Information CD that came with the source holder and the appropriate current regulations for details.

## Vertical pipe with upward flow

Mount the measuring assembly on a vertical pipe with upward flow of the process material. This position provides the best possible self-cleaning action, with a minimum possibility of gas or heavy solids collecting in the measuring section. You can mount the gauge on a horizontal pipe but a vertical flow is preferable. Keep the velocity above five feet per second to avoid build-up on the pipe walls and to keep the heavier solids in suspension. This is particularly true in sludge applications.

## Pump considerations

Mounting the density gauge near a pump can be good or bad depending on the application. Check with VEGA application engineers for a recommendation on your application.

## No line hammering

The design of the density gauge requires operation in low-vibration conditions. Install it in a location with no line hammering or excessive vibration. Quickly changing flow conditions

may cause line hammering. If necessary, you can physically mount the density gauge apart from the vessel or pipe, but notify VEGA at the time of the order to ensure proper source size and shielding.

## Stable temperature

Mount the gauge on a portion of the line where the temperature of the process material is relatively stable. Process temperature can effect the gauge indication. The amount of the effect depends upon the following:

- Sensitivity of the gauge
- Temperature coefficient of the process material

Temperature compensation is available, but requires an VEGA temperature probe in the process as an input to the gauge.

## Protect insulation

If insulation is between the measuring assembly and the process, protect the insulation from liquids. The absorption of a liquid, such as water, can affect the gauge indication because it blocks some radiation.

## No air entrainment

Mount the gauge on a portion of the line where there is no possibility of air or gas entrainment and where the pipe is always full of process material.

Air or gas entrainment in the process or a partially full pipe, can result in an inaccurate gauge indication.

## Standardization considerations

The gauge requires periodic standardization. Use process, absorber plates, or other easily repeatable reference fluid, such as water, for this standardization. You must be able to empty or fill the pipe with water if you plan to standardize with absorber plates or water. Often, you can purge the measuring section of a pipe by rerouting the process material through a bypass section.

## Avoid source cross-talk

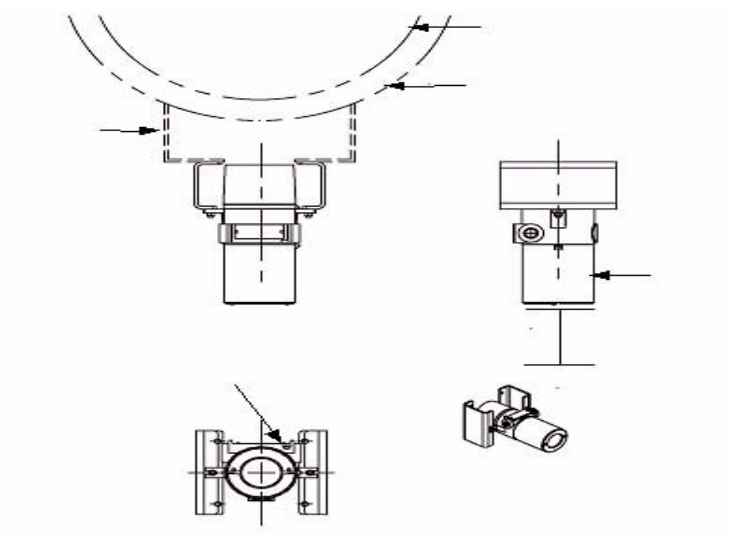
When multiple adjacent pipes or vessels have nuclear gauges, you must consider the orientation of the source beams so each gauge senses radiation only from its appropriate source.

The best orientation, in this case, is for the source holders to be on the inside with radiation beams pointing away from each other.

# Mounting the measuring assembly

You can mount the density gauge on the pipe by positioning the detector housing and source holder brackets with the bolts that VEGA provides. If the pipe has insulation, the density gauge and source holder should have external support to prevent crushing of the insulation.

**Note:** In some cases, the handle on the source holder operates a rotating shutter. When installing or removing the assembly from the pipe, you must turn the handle to the closed (OFF) position and lock the handle with the combination lock provided.



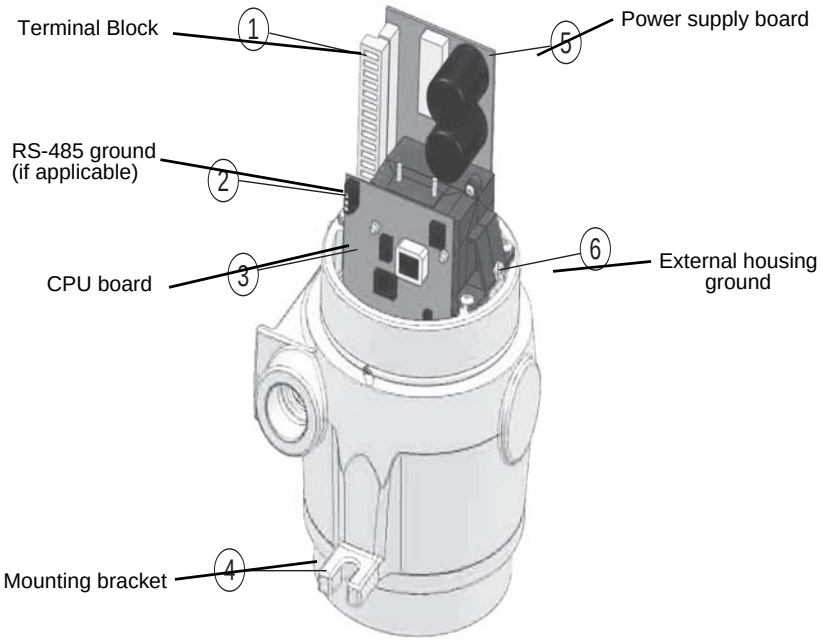
**Mounting the DSGH gauge**

# Wiring the equipment

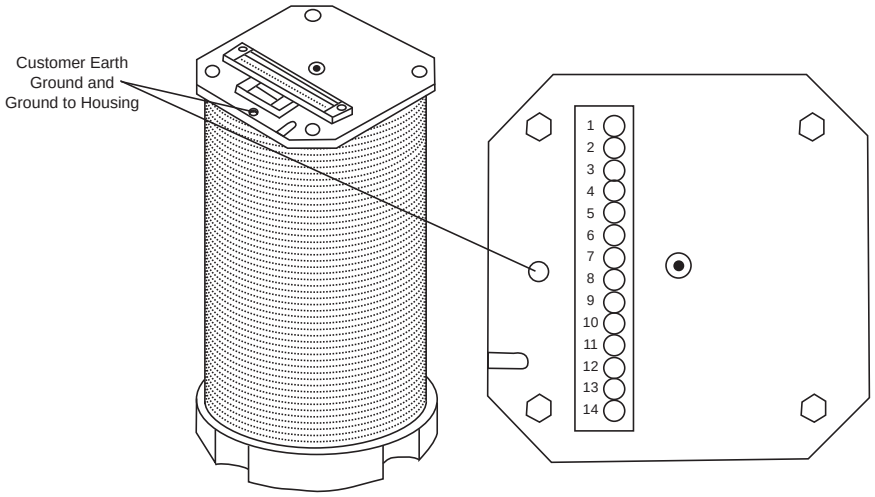
**Note:** If you received an interconnect drawing from VEGA or the engineering contractor and the instructions differ from the instructions in this manual, use the drawing. It may contain special instructions specific to your order.

Use the drawing notes and the steps that follow to make the input and output connections. Make the connections at the removable terminal strips mounted on the power board. To access the power board, remove the explosion-proof housing cap.

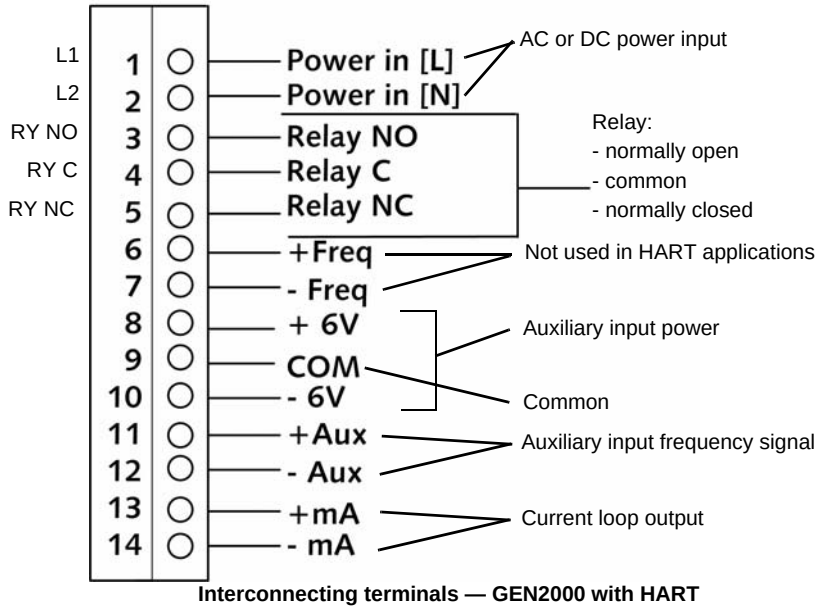
VEGA provides an internal and external ground screw to connect the power earth ground wire. Remove the top cover; the internal ground screw is located at the front of the housing. The external ground screw is located next to the conduit entry.




**DSG Exploded View**




DSG Perforated View




**Interconnecting terminals — GEN2000 with HART**

**Note:** Not all connections are required for operation. For example, Terminal 10 (-6V, Auxiliary Input Power) may not be used with newer electronics. The power input terminals are not polarity-sensitive.

## Power

***Caution:*** *Do not apply power until thoroughly checking all wiring.*

The AC power source voltage input is 100 – 230 VAC ± 10% (90 – 250 VAC) at 50 ... 60 Hz, at 15 W (or 25 W with optional heater) maximum power consumption.

AC power must not be shared with transient-producing loads. Use an individual AC lighting circuit. Supply a separate earth ground.

The DC power source voltage input is 20 – 60 VDC (< 100 mV, 1 ...1,000 Hz ripple) at 15 VA maximum power consumption. DC power cable can be part of a single cable 4-wire hookup, or can be separate from output signal cable. (See Output current loop section.)

Use wire for power per local code. Use supply wire suitable for 40 °C above surrounding ambient temperature. All field wiring must have insulation suitable for 250 volts or higher.

**Note:** HART signal may not operate with some isolating barriers or other non-resistive loads.

## Switch for CE compliance

For CE compliance, install a power line switch ≤ 1 m from the operator's control station.

## Output current loop

Output signal is 4 mA ... 20 mA into 250 – 800 Ω. Pin 13 is + and Pin 14 is -. HART communication protocol (BEL202 FSK standard) is available on these connections. The output is isolated to standard ISA 50.1 Type 4 Class U.

When using signal (current loop or 4 mA ... 20 mA output) cables that VEGA did not supply, they must meet these specifications:

- Maximum cable length is 1,000 m (3,280')
- All wires should be per local code

When using DC power, the signal and power can run on a single cable 4-wire hookup (2 wires for power, 2 for 4 mA ... 20 mA).

### Relay

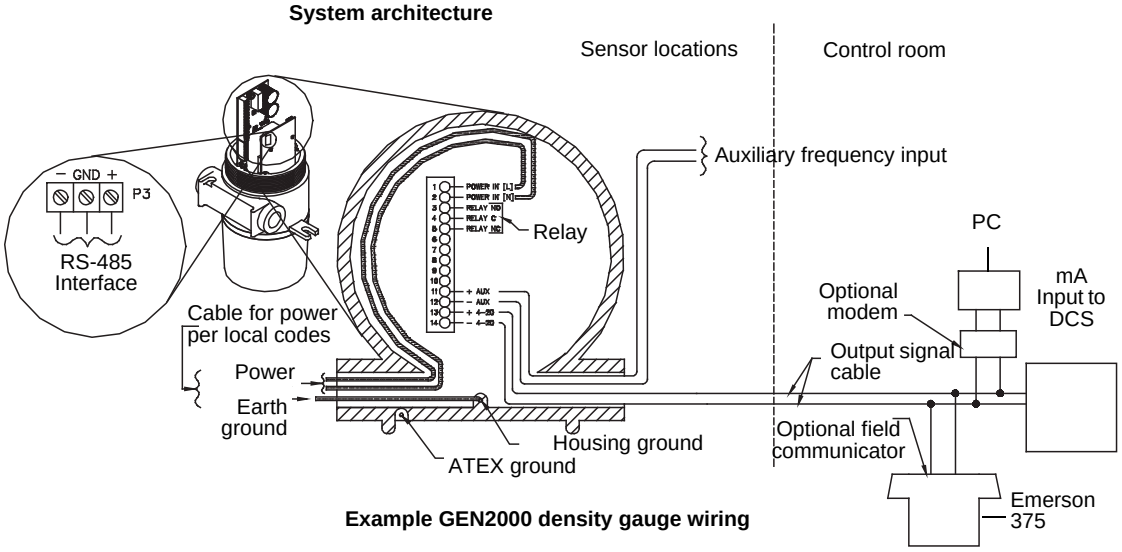
Use relay contacts rated at 6 A at 240 VAC, 6 A at 24 VDC, or 1/4 HP at 120 VAC. Frequency input signal is 0 ... 100 kHz ≤, true digital.

### RS-485

The maximum cable length is 609 meters (2,000'). Use shielded wire per local code.

Connect positive terminals together. Connect negative terminals together. Connect ground terminals together.

**System architecture**




**Example GEN2000 density gauge wiring**

## Communication

The HART hand-held terminal can connect anywhere across the 4 mA ... 20 mA wires to communicate with the gauge. A minimum requirement is a 250 Ω load-resistance on the current loop. A HART modem may connect across the 4 mA ... 20 mA wires to enable communication between the gauge and a PC.

## Process alarm override switch

If the output relay is set as a process alarm relay (high- or low-density alarm), you can install an override switch to manually deactivate the alarm. If you do not, the process alarm relay de-energizes only when the measured density is out of the alarm condition.

## Conduit

Conduit runs must be continuous and you must provide protection to prevent conduit moisture condensation from dripping into any housings or junction boxes. Use sealant in the conduit, or arrange the runs so they are below the entries to the housings and use weep holes where permitted.

You must use a conduit seal-off near the housing when located in a hazardous area. Distance must comply with local code.

If you use only one conduit hub, plug the other one to prevent dirt and moisture from entering.

# Commissioning the gauge

Depending on the source holder's type, the process of commissioning the gauge can include:

- Taking appropriate radiation field tests
- Checking the pre-programmed setup parameters
- Calibrating on process
- Verifying the working of the gauge

You must remove the source holder lock or shield the first time the gauge takes measurements in the field. Only persons with a specific license from the U.S. NRC, Agreement State, or other nuclear regulatory body may remove the source holder lock.

**Note:** Users outside the U.S. must comply with the appropriate nuclear regulatory body's regulations in matters pertaining to licensing and handling the equipment.

**Note:** See the Radiation Safety for U.S. General and Specific Licensees, Canadian and International Users Manual and the Radiation Safety Manual Addendum of Reference Information CD that came with the source holder and the appropriate current regulations for details.

## Field service commissioning call checklist

In many U.S. installations, an VEGA field service engineer commissions the gauge. To reduce service time and costs, use this checklist to ensure the gauge is ready for commission before the engineer arrives:

☑ Mount the source holder and detector per the VEGA certified drawings.

☑ Allow access for future maintenance.

☑ Make all wiring connections per the certified drawings and page 2-5. Tie in the wiring from the field transmitter analog output to the distributed control system (DCS)/ programmable logic controller (PLC)/chart recorder.

☑ Ensure that the AC power to the transmitter is a regulated transient-free power source. UPS type power is the best.

☑ If using DC power, verify that the ripple is < 100 mV, 1 ... 1,000 Hz at 15 W.

**Note:** The equipment warranty is void if there is damage to the gauge due to incorrect wiring not checked by the VEGA field service engineer.

☑ Have process ready for calibration.

- ☑ When possible, have process available near both the low and high end of the measurement span. A density change of at minimum of 0.1 SpG is a common requirement.
- ☑ When possible, have the material used for periodic standardization of the gauge available (usually water).
- ☑ Do not remove the lock or shield on the source holder. Notify VEGA Field Service if there is damage to the source holder.

CHAPTER

# 3

# CALIBRATION

Before using the gauge to make measurements, you must:

- Calibrate it to relate the detection of radiation from the source to the density of the process material.
- Calibrate the current loop to a reference ammeter or the DCS.
- Periodically, you must standardize the system on process to adjust for changes over time.

Calibration establishes a reference point or points that relate the detector output to actual (or known) values of the process.

You must make a calibration before the gauge can make accurate measurements. Perform the calibration after the installation and commission of the gauge at the field site.

You do not need to repeat the calibration procedures if certain critical process and equipment conditions remain unchanged.The gauge requires only a periodic standardization to compensate for changing conditions

## Current loop (analog output) calibration

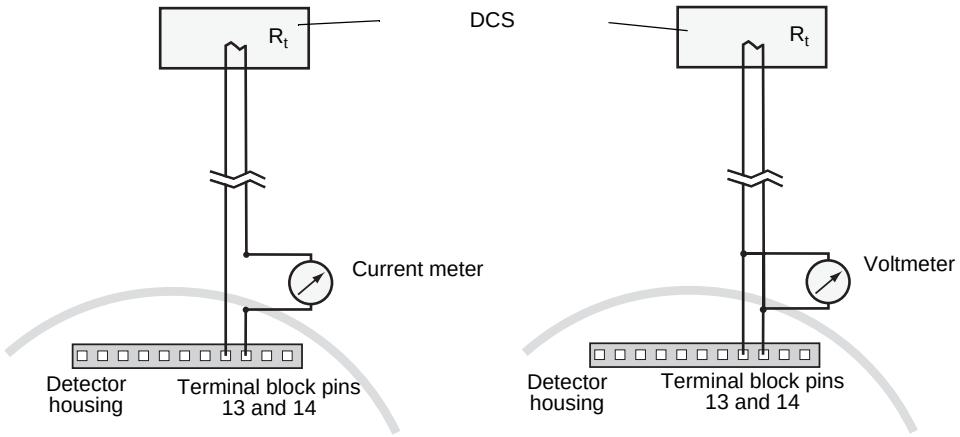
Calibrating the current loop adjusts the 4 mA ... 20 mA output to a reference, the PLC/ DCS or a certified ammeter. It forces the 4 mA and 20 mA outputs to the external reference. The VEGA factory pre-adjusts the current loop with a certified ammeter, so it is very close to the outputs required.

To correlate the 4 mA ... 20 mA to the process value, set the span of the current loop output.

**Note:** The current loop and process spans are independent and set separately. The current loop span sets the density indications for the 4 mA and the 20 mA outputs. The process span sets the endpoints of the calibration curve.

A direct measurement of the current is preferable: hook the meter up in series with the instrument and the DCS. However, if you know the resistance of the DCS, use a voltage measurement to calculate the current.

## Measuring the current loop output

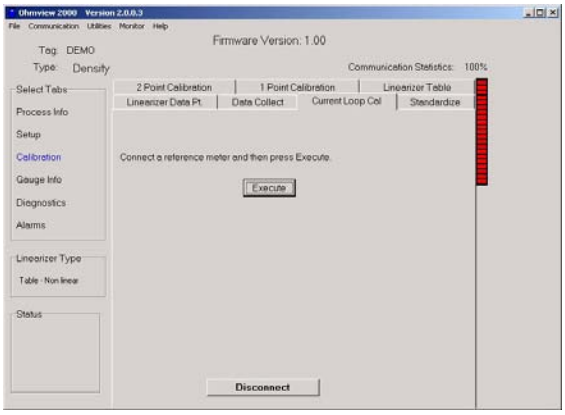



Before a current loop calibration:

☑ Connect an ammeter or the DCS to:

- Terminal connections 13 (mA +) and 14 (mA -)
- Test points H1 and H2
- Anywhere along the current loop

☑ Make sure there is a 250 – 800 Ω load on the current loop. If no load or an insufficient load exists on the loop, it may require temporary placement of a resistor across terminals 13 and 14. Hook the meter or DCS in series with the load resistor.




***Procedure 3.1: To calibrate the current loop***

1. Select **Calibration** | **Current Loop Cal**.
2. Click **Execute.**
3. Click **OK**.
4. Read the ammeter; enter the actual milliamp reading.

   **Note:** If using a voltmeter, calculate the current value.

5. Click **OK**.
6. Click **YES** if the ammeter reads 4.00 mA or **NO** for any other reading.
7. Repeat until the meter reads 4.00 mA. The meter approaches the 4.00 mA successively.
8. Read the ammeter; enter the actual milliamp reading.
9. Click **OK**.
10. Click **OK**.

You can check the current loop output calibration at any time by using the test mode to output a user-specified milliamp setting. See page 4-7.

# Choosing the linearizer type

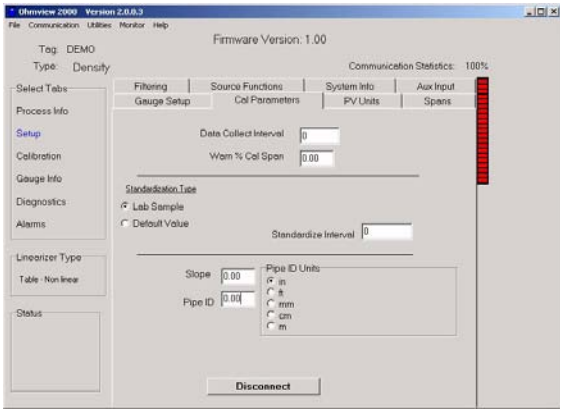
The gauge's response curve is non-linear, due to the measurement method of radiation transmission. The linearizer determines the shape of the curve between the endpoints.

The gauge's linearizer type is part of the signal processing necessary to produce a linear final output with respect to the change in density of process material.

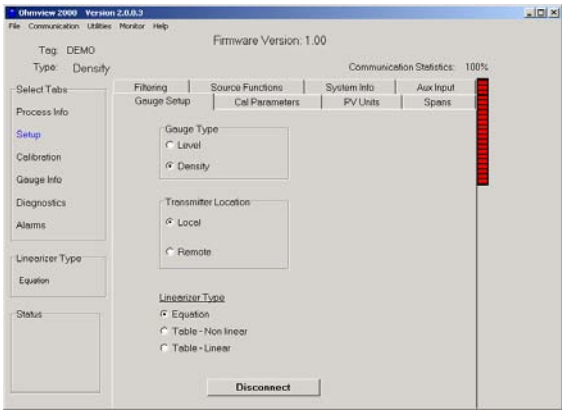
The majority of density applications use the equation linearizer method to perform the one-point calibration method. For density applications, the equation is the default and we recommend it in most circumstances. If the results from the equation linearizer method are not satisfactory, contact VEGA Field service to further explain the other options.

The linearizer equation calculates a density reading for a given count reading at the detector. To make the correction calculation, it relies on the following information:

- Vessel's inner diameter system parameter
- Span settings parameter
- Data used in the calibration
- Absorption co-efficient




The equation linearizer is appropriate for a one or two-point calibration.



### *Procedure 3.2: To choose an equation linearizer type*

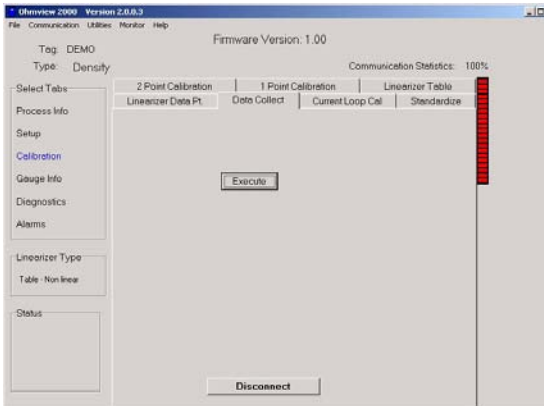
1. Select **Setup | Gauge Setup | Linearizer Type**.
2. Click **Equation**.

# Checking the gauge repeatability

Check the gauge's measurement repeatability before performing the calibration.

To check the repeatability of the sensor, perform a data collection 3 – 4 times on the same sample. If the sensor counts vary widely, you should increase the Data collection interval parameter.

Perform a data collection to enable simple measurement of the process, without altering the calibration or standardization values. It lets the system measure the process and report the number of sensor counts.




### *Procedure 3.3: To perform a data collection*

1. Select **Calibrations** | **Data Collect**.
2. Click **Execute**.
3. Set the process to a known point.
4. Click **Start**.

   After the data collection, the number of counts output by the gauge appears.
5. Click **Accept**.
6. Repeat as often as necessary if checking repeatability.

# Calibration

The recommended calibration for a density gauges is a two-point calibration. The two-point calibration measures the low and high process conditions.

**Note:** The two-point calibration method is useful in conjunction with any linearizer method.

The two-point calibration method involves three main steps:

1. Setting the low density
2. Setting the high density
3. Calculating the calibration

## 1 Setting the low density and collecting Cal Low data

You must:

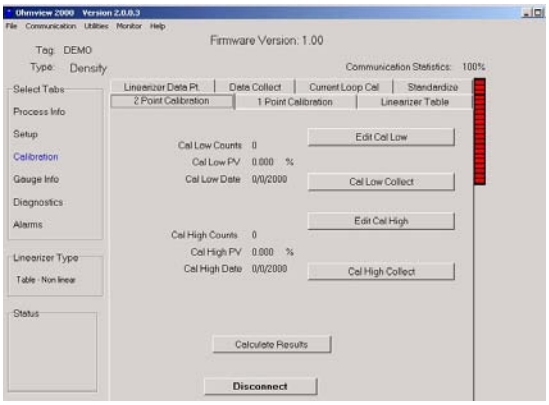
1. Use the gauge to measure the low process density.
2. Enter the actual density.

This sets the low end (sometimes called 0) of the calibration curve. Perform this procedure before or after setting the high density.

**Note:** Perform the data collection for the low and high density within 10 days of each other for a good calibration. The low and high values must be more than 10% of the process span apart for the most accurate calibration. Increasing the process span usually increases the gauge accuracy.

Before starting the Cal Low data collection:

- ☑ Check that the correct parameters (vessel inner diameter, engineering units, measurement span, and source type) are correct.
- ☑ Power up gauge one hour before start of calibration.
- ☑ Fill vessel or pipe with low process.
- ☑ Prepare to draw a sample while the gauge is collecting data.




***Procedure 3.4: To set the cal low density***

1. Select **Calibration | 2 Point Calibration | Cal Low Collect**.
2. Click **Start**.
3. Click **Accept**.
4. Enter the actual value in engineering units.
5. Click **OK**.

## 2 Setting the high density and collecting Cal High data

You must:

- Use the gauge to measure the high process condition.
- Enter the actual density.

This sets the gain of the calibration curve. Perform this procedure before or after setting the low density.

Before starting the Cal High data collection:

☑ Check that the correct parameters (vessel inner diameter, engineering units, measurement span, and source type) are correct.

☑ Power up gauge one hour before start of calibration.

☑ Fill vessel or pipe with high process or close the source holder shutter to simulate high process.

☑ Prepare to draw a sample while the gauge is collecting data.

***Procedure 3.5: To set the cal high density***

1. Select **Calibration | 2 Point Calibration | Cal High Collect**.
2. Select **Start**.
3. Click **Accept**.
4. Enter the actual density process value (from the laboratory) in engineering units.
5. Click **OK**.

### 3 Calculating the calibration

***Procedure 3.6: To calculate the calibration***

1. Select **Calibration | 2 Point Calibration**.
2. Click **Calculate Results**.
3. Click **OK**.
4. Click **OK**.

## Repeating the calibration

Typically, the system requires only periodic standardization to compensate for drifts over time.

However, these events require you to repeat the calibration:

- Measurement of a new process application (contact VEGA for recommendation)
- Process requires a new measurement span
- Entering a new measurement span setting into the software
- Installing a new radiation source holder
- Moving the gauge to another location
- Changes to pipe size, schedule, or any other change in process piping
- Excessive buildup or erosion of pipe that standardization cannot compensate for (check standardize gain)
- Standardize gain > 1.2 after a standardization, indicating it made a 20% adjustment from the previous calibration

## Periodic standardization

Standardization adjusts the system by resetting one point of the calibration curve to an independently measured or known sample.

The frequency of standardization depends on several factors, including the reading's accuracy.

During the standardization procedure, the system displays:

- A default value for the standardization condition
- A prompt to enter the actual process value of the standardization condition

## Standardization reminder

If you enable the standardization due alarm, the gauge produces an alarm when standardization is due. The standardize interval is programmed in **Setup | Cal Parameters**.

You can perform a standardization using any of the following:

- Process
- Water (or other repeatable fluid)
- Absorber plates

### Standardization on water

Standardization on water is the best choice if water is readily obtainable. For example, if the process is water based or if the process is slurry with water as the carrier.

**Note:** This method requires you to select Default Value and enter the Standardize Default Value on the SetUp | Cal Parameters tab.

Advantages: If the source of water is of consistent purity (for example, city vs. pond), standardization on water is highly accurate. Water is a good choice if the density of the process is around 1.0SpG because standardization on water would be within the process span. This ensures high accuracy at the point on the calibration curve.

Disadvantages: You must be able to empty and fill the process pipe with a consistent source of water.

### Standardization on process

This method requires measuring the process in the pipe with the density gauge and entering the laboratory measured density into the software.

**Note:** Select Lab Sample on the Setup | Cal Parameters tab.

Advantages: Standardization on process is the easiest method. It ensures the density gauge reads what the laboratory reads at that density.

Disadvantages: It is not the most accurate or repeatable method. In addition, it requires a laboratory for results.

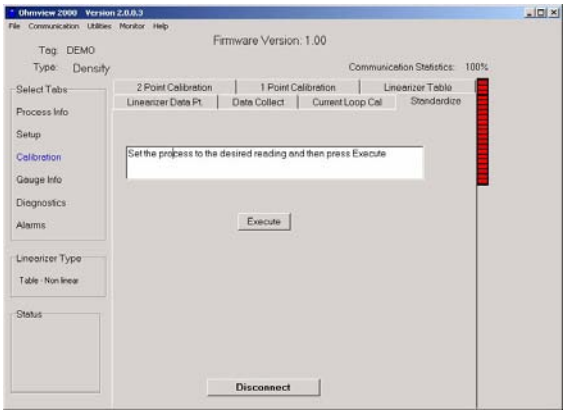
## Standardization on absorber plates

**Note:** This method requires you to select Default Value and enter the Standardize Default Value on the SetUp | Cal Parameters tab.

Absorber plates have the following features:

- Usually made of lead.
- Insert into slots in front of the gauge.
- Require a mounting kit from VEGA.
- Require the use of the same plates to ensure a consistent absorption of radiation (this is a substitute for the radiation absorption of the material in the pipe.

Requires emptying process from the pipe and access to the measuring assembly




**Note:** You cannot use absorber plates for the initial process calibration. You must determine the equivalent value of the absorber plates after the initial process calibration of the density gauge when the gauge was mounted to the pipe.

### *Procedure 3.7: To standardize the gauge*

1. Select **Calibration | Standardize**.
2. Click **Execute**.

3. Click **OK**.
4. Enter the reading.
5. Click **Start**.
6. Click **Accept**.
7. Enter the process value.
8. Click **OK**.
9. Click **OK**.

CHAPTER

# 4

# ADVANCED FUNCTIONS

Functions not required for normal operation of the gauge are in the Ohmview2000 software under the Diagnostics and Gauge Info tabs. These functions are primarily for use by VEGA personnel for advanced troubleshooting and repair.

**Note:** VEGA strongly recommends that you ask our advice before using any advanced function.

## Process chain

The process chain is a description of the gauge software's calculation of a density measurement from a radiation reading. In the **Process Chain** tab, you can view intermediate values of the calculation to verify proper functionality of the software.

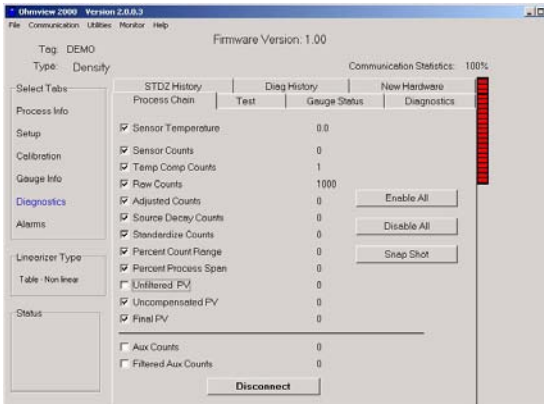


**Table 4.1** Process Chain tab — display values

| Value | Description |
|---|---|
| Sensor Temperature | The internal probe's measurement of the sensor temperature. |
| Sensor Counts | True counts output from the sensor, but before application of:<br>• Temperature compensation<br>• Standardize<br>• Sensor uniformity gains |
| Temp Comp Counts | The temperature-compensated counts that are sensor counts with application of temperature compensation. |
| Raw Counts | Temperature compensated counts with application of uniformity gain. |
| Adjusted Counts | Sum counts that are raw counts plus auxiliary raw counts. In most applications, this does not use auxiliary input, so sum counts = raw counts. |
| Source Decay Counts | Sum counts with application of source decay gain. |
| Standardize Counts | Displays standardize counts that are source decay counts with application of standardization gain. |
| Percent Count Range | The compensated measurement counts that express as a percent of the counts at the high and low-endpoints of the calibration (determined with the two point initial calibration.) This quantity shows where the current measurement is in relation to the total count range.<br>% count range = 100 x ($C_L$ - $C_S$) / ($C_L$ - $C_H$)<br>where<br>$C_S$ = sum counts<br>$C_L$,$C_H$ = counts at Cal Low density and Cal High density<br>$C_L$-$C_H$ = counts range |
| Percent Process Span | The measurement value as a percent of the measurement span. Enter the maximum and minimum density values in the Setup tab.<br>A graph of percent count range vs. percent process span indicates the non-linearity of the radiation transmission's measurement. If using a table linearizer, the values in the table are percent count range and percent process span. |
| Unfiltered PV | The density in inches without the time constant or rectangular window filter. |
| Uncompensated PV | The density of process before any process compensation. |
| Final PV | The process value in engineering units after applying the filter.This value relates to the current loop output. |
| Aux Counts | The frequency-input counts from optional auxiliary input. |
| Filtered Aux Counts | The filtered auxiliary counts. Enter the filter dampening value for the auxiliary input's filter time-constant. |

# Gauge Information

## Process Variables tab

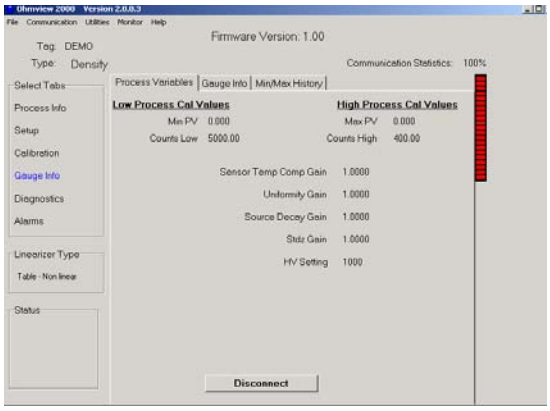



**Table 4.2** Process Variables tab — display values

| Value | Description |
|---|---|
| Min PV | The value, in process units, as entered in the setup tab. Use this to calculate the measurement span. |
| Max PV | |
| Counts Low | The temperature and sensor uniformity gain compensated counts from the sensor at the Cal low density. Determining the Cal low density occurs during the calibration. |
| Counts High | The temperature and sensor uniformity gain compensated counts from the sensor at the Cal high density. Determining the Cal high density occurs during the calibration. |
| Sensor Temp Comp Gain | The current value of the temperature compensation gain. Use this to adjust for inherent sensor output change with temperature. |
| Uniformity Gain | Displays the current value of the uniformity gain. Use this to force all density gauge sensors to output the same counts at a given radiation field |
| Source Decay Gain | The current value of the source decay gain. Use this to compensate for the natural decay of the radiation source, which produces a lower field over time. |
| Stdz Gain | The current value of the standardize gain that adjusts with each standardize procedure. |
| HV Setting | The set point for the sensor high voltage. |

## Gauge Info tab

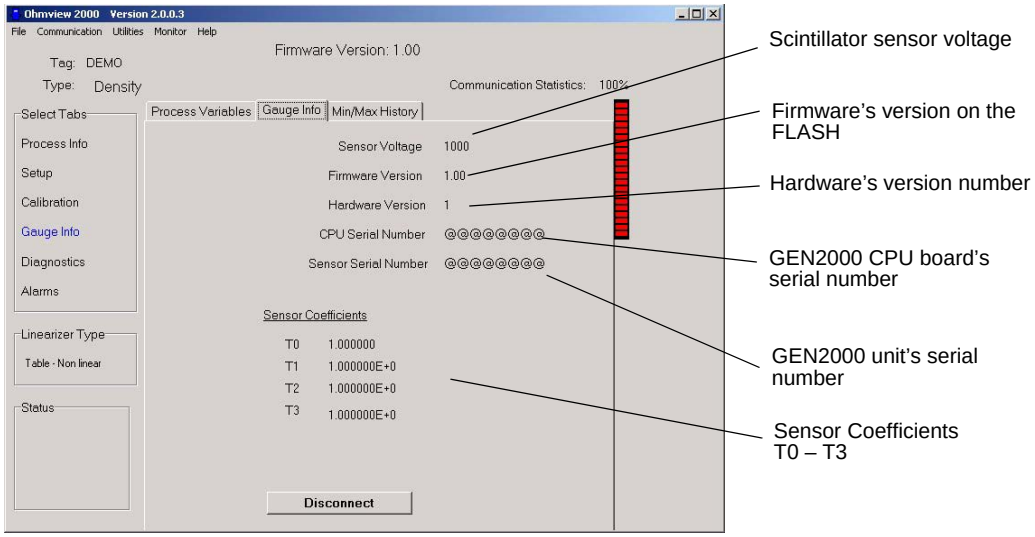



**Table 4.3** Gauge Info tab — additional display values

| Value | Description |
|---|---|
| Sensor Coefficients | The algorithm that compensates for variations in measurement output with changes in temperature uses temperature coefficients. The factory determines the coefficients through rigorous testing. You cannot change them through normal operation. |

### *Procedure 4.1: To check the equipment version, serial numbers, and temperature coefficients*

1. Select **Gauge Info | Gauge Info**.
2. The Gauge Info tab appears.

## Min/Max History tab

The Min/Max History displays the minimum and maximum values for parameters since the last min/max reset.

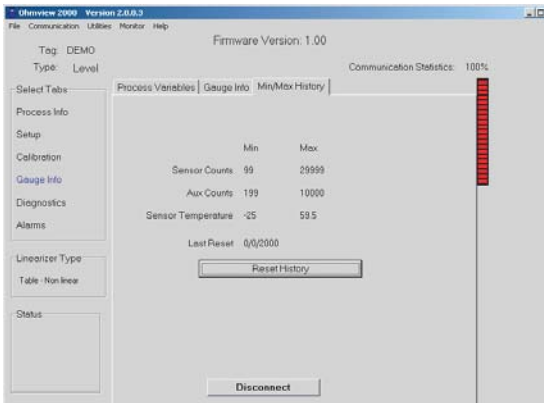



**Table 4.4** Min/Max History tab — display values

| Value | Description |
|---|---|
| Sensor counts | The raw uncompensated counts from the detector |
| Aux in min/max | The auxiliary input counts (if used) |
| Sensor Temperature | The internal temperature of the scintillator sensor in the gauge |
| Last reset | The date of the last min/max reset |

You can reset these values so they record from the time of the reset.

***Procedure 4.2: To reset the min/max history***

1. Select **Gauge Info | Min/Max History**.
2. Click **Reset History**.

# New hardware or corrupt EEPROM

The gauge contains 2 EEPROMs (electrically erasable programmable read only memory) that store all data specific to that sensor/electronics pair for the installation.

The EEPROMs are located:

- On the CPU board
- On the sensor board

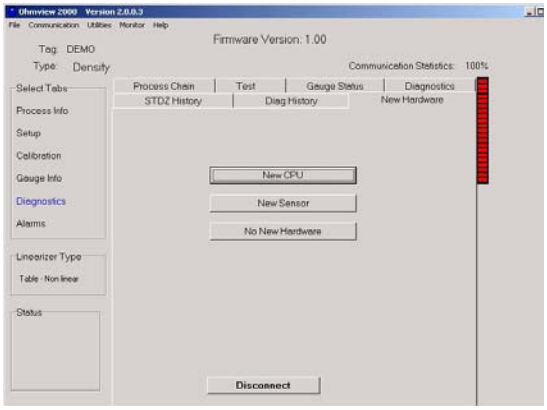
Each EEPROM contains a backup of the other. The system monitors both EEPROMs at power-up to ensure accurate backups.

If you install a new CPU board, the EEPROM performs a backup of information on the CPU. The sensor boards memory does not match the CPU board memory. The software

signals the discrepancy with an error message. The gauge does not perform a backup in case the discrepancy is due to EEPROM corruption rather than new hardware.

**Note:** Only use the **New hardware** functions if you replace the CPU or sensor assembly. These functions are unnecessary if installing a new detector assembly, which includes the CPU board and the sensor assembly.

## New Hardware tab




## Responding to the New hardware found message

### When new hardware is installed

When you install a new CPU board or sensor assembly, you must verify installation in Ohmview 2000 to enable new backups of the EEPROMs.

***Procedure 4.3: To verify the "New Hardware Found" message***

1. Select **Diagnostics | New hardware | New CPU** or **New Sensor**.
2. Click **OK**.

### When new hardware is not installed

If the error message New hardware found appears, an EEPROM is probably corrupt.

The messages "CPU EEPROM Corrupt" or "Sensor EEPROM Corrupt" may also appear in the history.

Usually, you can repair the corruption using the EEPROM backup.

***Caution:*** *If you suspect an EEPROM is corrupt, please call VEGA Field Service for advice before performing the following procedure.*

***Procedure 4.4: To repair the corruption using the EEPROM backup***

1. Select **Diagnostics | New Hardware | No New Hardware**.
2. Click **OK**.

# Test modes

In the test modes, the transmitter stops measuring the process material and allows manual adjustment of critical variables for troubleshooting.

The test modes function independently, but you can use them in combination to test multiple variable effects.

All test modes time out after one hour if you do not exit.

***Caution:*** *While in a test mode, the gauge is not measuring process, so its current output does not reflect the process value. If your DCS is controlling from the gauge's current output, remove the system from automatic control before entering a test mode, as prompted by the software screens.*

## Test tab

## Current Loop Test (milliamp output)

This mode manually forces the current output to a specified value. This is useful for verifying the current loop calibration. To calibrate the current loop, see Chapter 3: Calibration.

***Procedure 4.5: To perform a current loop test***

1. Select **Diagnostics | Test | Current Loop Test**.
2. Click **Enter**.
3. Remove the gauge from control.
4. Enter the current loop test value.

5. Click **OK**.

   The transmitter functions in this mode until it times out (1 hour), or you click **Exit** and **OK**.

## Sensor Test

This mode simulates the sensor output at a number of raw counts you define. This is before application of:

- Temperature compensation
- Sensor uniformity gain
- Standardize gain

The true sensor output is ignored while the transmitter is in sensor test mode.

This mode is useful for verifying the electronics and software response to input counts without having to:

- Change the process
- Shield the source
- Vary the radiation field

While in this mode, after entering a number of counts, it may be useful to look at the **Process Chain** tab to view the variables affected by the raw counts value.

### *Procedure 4.6: To perform a sensor test*

1. Select **Diagnostics | Test | Sensor Test**.
2. Click **Enter**.
3. Remove the gauge from control. Enter the value of the new counts to force.
4. Click **OK**.

   The transmitter functions in this mode until it times out (1 hour), or you click **Exit** and **OK**.

## Auxiliary Input Test

This mode simulates the auxiliary input frequency at a user-defined number of counts. The effect of auxiliary input counts depends on the auxiliary input mode.

Examples:

- Temperature probe
- Flow meter

- Second transmitter

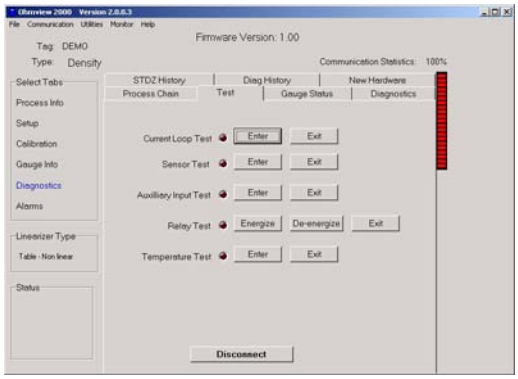
While in this mode, after entering a number of counts, it may be useful to look at the **Process Chain** tab to view the variables affected by the auxiliary input counts value.

### *Procedure 4.7: To perform an auxiliary input test*

1. Select **Diagnostics | Test | Auxiliary Input Test**.
2. Click **Enter**.
3. Remove the gauge from control. Enter the auxiliary counts.
4. Click **OK**.

   The transmitter functions in this mode until it times out (1 hour), or you click **Exit** and **OK**.

## Relay Test




This mode manually toggles the relay On or Off to test the contacts. This is useful for verifying whether alarm annunciators are functioning.

### *Procedure 4.8: To perform a relay test*

1 Select **Diagnostics | Test | Relay Test**.

2 Select **Energize relay** or **De-energize relay**.

3 The transmitter functions in this mode until it times out (1 hour), or you click **Exit**.

## Temperature Test

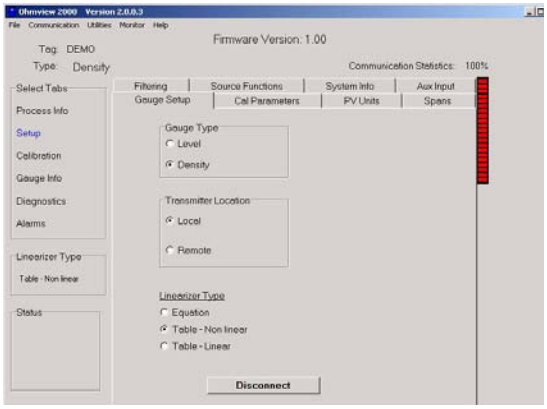
This mode manually forces the sensor's temperature probe output to a specified value. This is useful for verifying the scintillator sensor temperature compensation.

***Procedure 4.9: To perform a temperature test***

1. Select **Diagnostics | Test | Temperature Test**.
2. Click **Enter**.
3. Remove the gauge from control. Enter the value of the new temperature to force.
4. Click **OK**.
5. The transmitter functions in this mode until it times out (1 hour), or you click **Exit** and **OK**.

# Selecting the transmitter's type and location

## Gauge Setup tab




## Type

The GEN2000 level and density gauges look similar and use the same software. If your density transmitter indicates Level, it was set incorrectly for a density application.

***Procedure 4.10: To select the transmitter's type***

1. Select **Setup | Gauge Setup | Gauge Type**.
2. Select **Density**.

## Location

The local transmitter refers to a gauge that has its sensor electronics and processing electronics all contained in the same housing.

Set a gauge to Remote if the sensor electronics and processing electronics are in separate housings and the process signal connects to the auxiliary input of the processing electronics.

### *Procedure 4.11: To select the transmitter's location*

1. Select **Setup | Gauge Setup | Transmitter Location**.
2. Select **Local** or **Remote**.

# Notes:

CHAPTER 5

# DIAGNOSTICS AND REPAIR

## Software diagnostics

The density transmitter system can alert users to potential problems by:

- Posting messages on the Ohmview 2000 message screen
- Energizing the output relay
- Distinctly changing the current loop output
- Tracking the current status and history in the Gauge status screens

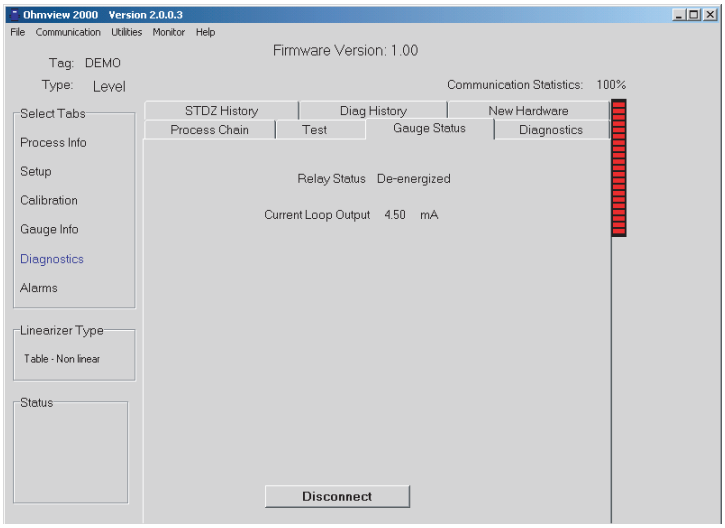
**Table 5.1** Alarm types

| Name | Description |
|---|---|
| Diagnostic alarm | Provides information about the density gauge system and alerts users when periodic procedures are due. |
| Analog alarm | Sets the current loop mA output to 2 mA or 22 mA when the detector outputs 0 counts. |
| Process alarm | The process alarm lets the relay output trip when the process density is above (high limit) or below (low limit) a setpoint. |
| X-ray alarm | Distinctly changes the current loop mA output in response to a marked increase in the radiation field. This prevents control problems when external radiographic sources are in the area for vessel inspections. |

**Table 5.2** Alarm type outputs

| | Diagnostic | Analog | Process | X-ray |
|---|---|---|---|---|
| Option to trigger relay | X | | X | X |
| Display HART message | Optional | | | |
| Current loop output affected | | X | | X |
| Gauge status and gauge history | X | | | |

## Gauge Status tab

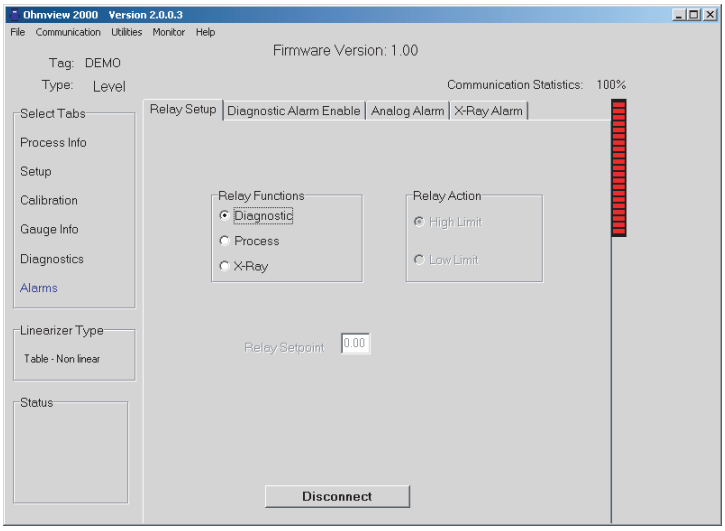



# Diagnostic alarms and HART messages

Diagnostic conditions that are currently in alarm alert users by:

- Diagnostics screens in the **Messages** box on the main Ohmview 2000 screen
- HART messages that appear when a HART device connects if the diagnostic condition is selected in **Alarms** | **Diagnostic Alarm Enable**
- Relay output if it is set as a diagnostic alarm relay in **Alarms** | **Relay Setup** | **Relay Functions**

## Relay Setup




## Gauge status diagnostics screens

- To check the system's present status, select **Diagnostics | Diagnostics** tab.
- For historical information, select the **Diagnostic History** and **STDZ History** tabs.

Some conditions are self-repairing (example: RAM and EEPROM corruption). Therefore, these may appear in history screens but not diagnostic screens.

## Acknowledging diagnostic alarms

Diagnostic alarms turn off when the problem is solved, except these alarms:

- Source wipe due
- Shutter check due
- Standardize due

Perform the procedure to acknowledge them.

**Note:** If the relay is set as a diagnostic alarm, you must acknowledge all diagnostic alarms to reset the relay.

## Diagnostic alarm messages

Active alarm messages may appear on the Ohmview 2000 menu if the alarm condition is selected. You can select individual alarm conditions in the **Alarms | Diagnostic Alarm Enable** tab.

When a HART device initially connects to the gauge, any conditions in alarm appear on the screen.

**Table 5.3** Diagnostic alarm conditions

| Diagnostic check and Normal/Error conditions | HART message<br>Diagnostic description | Action |
|---|---|---|
| RAM Status – Pass/ Fail | RAM corrupt<br>RAM memory corruption occurred and was resolved internally. Repeated triggering of this alarm suggests a hardware problem. | Consult VEGA Field Service. |
| Sensor EEPROM – Pass/Fail | Sensor EEPROM corrupt<br>A critical memory corruption occurred on the sensor pre-amp board EEPROM that may not be resolved internally. | To check for recurrence, acknowledge the alarm. Cycle power to the unit.<br>If the alarm recurs, there is a hardware problem. Perform the procedure to repair the corrupted EEPROM on page 4-7. |
| Real Time Clock Status – Pass/Fail | Real time clock fail<br>The clock failed. This can cause a miscalculation of timed events. (If the gauge had no power for > 28 days, reset the time and date.) | Reset the time and date. If they do not reset, call VEGA Field Service. |
| Sensor Temp Probe – Pass/Fail | Sensor temp probe fail<br>The sensor temperature probe may not be functioning, which results in erroneous measurements. | Verify the sensor temperature on the **Gauge Info \| Min/Max History** tab. If the temperature reads -0.5 °C constantly, the probe is broken and the sensor assembly may need replacement. Call VEGA Field Service. |
| Source wipe due – No/Yes | Source wipe due | Acknowledge the alarm by logging a shutter check in the **Source Functions** tab. See page 5-14. |
| CPU EEPROM – Pass/Fail | CPU EEPROM corrupt<br>A critical memory corruption occurred on the CPU board EEPROM that may not be resolved internally. | To check for recurrence, acknowledge the alarm. Cycle power to the unit.<br>If the alarm recurs, there is a hardware problem. Perform the procedure to repair the corrupted EEPROM on page 4-7. |

**Table 5.3** Diagnostic alarm conditions (continued)

| Diagnostic check and Normal/Error conditions | HART message Diagnostic description | Action |
|---|---|---|
| Alarm type 1 – Not used | Not used in standard software. | Consult VEGA special software. |
| Alarm type 2 – Not used | Not used in standard software. | Consult VEGA special software. |
| Sensor Status? – Pass/Fail | Sensor fail<br><1 count seen in the last 10 seconds. (Configurable by Field Service.) Indicates the sensor is malfunctioning. | Call VEGA Field Service. |
| Sensor Voltage Status – Pass/Fail | Sensor high voltage fail<br>The high voltage on the PMT is outside the usable range. | Call VEGA Field Service. |
| Standardize Due – No/Yes | Standardize Due | Perform a new standardization |
| Source Wipe Due – No/Yes | Source Wipe Due | Perform a source wipe. Acknowledge it on the **Source Functions** tab. |
| Shutter check due? – No/Yes | Shutter Check Due | Perform a Shutter Check. Acknowledge it on the **Source Functions** tab. |
| New hardware found? – No/Yes | New hardware found – The CPU board detects a configuration mismatch. The CPU board or sensor assembly may have been replaced, or one of the EEPROM configurations is erroneous. | See page 4-7. |
| Process out of range? – No/Yes | Process out of measurement range – The current process value is not within the limits set by the Max density and Min density in the gauge span settings. | Call VEGA Field Service. |
| X-Ray Alarm – No/ Yes | Note that there are high levels of x-rays in your area that may be affecting process measurement. | Contact VEGA for further information. |

## Analog alarm

If the current loop output (analog output) is stable at 2 mA or 22 mA, the analog alarm is set.

The analog alarm is set when the counts from the detector fall below a set threshold, indicating that the detector is not outputting enough counts to make a meaningful measurement. This is known as 0 counts.

If the analog alarm is on, verify:

- ☑ Source holder shutter is in the On or Open position to create the required radiation field.
- ☑ Extreme build-up on walls or other material shielding the detector from the radiation field.
- ☑ Damage or disconnection of electrical connections from the sensor assembly to the CPU board.

## Process alarm

This alarm alerts users when the process density is above (high limit) or below (low limit) a setpoint. Enter the choice of low or high limit and the setpoint on the **Alarm** | **Relay Setup** tab.

This alarm works only with the output relay. HART messages, gauge status diagnostics, and history information are not saved for this alarm.

The gauge acknowledges or resets the process alarm when the process value returns to the setpoint value. Depending on your usage of the process alarm relay, you may install a process alarm override switch to manually turn off an annunciator when the gauge relay energizes.

## X-ray alarm

This alarm compensates for falsely indicated process values that occur when the gauge detects external radiographic sources (example: vessel weld inspections often use portable radiographic (x-ray) sources). X-rays that the gauge detects can cause a false low reading and adversely affect any control based on the gauge output.

This alarm can:

- Alter the current loop output to indicate the alarm condition
- Trip the output relay, if it is configured to do so

The gauge enters the x-ray alarm condition when it detects a radiation field above a set threshold. The gauge sets the current loop output at its value 10 seconds before the condition. It periodically dithers the output about the average, cycling until the radiation field is back to the normal density or until a time-out period of 60 minutes.

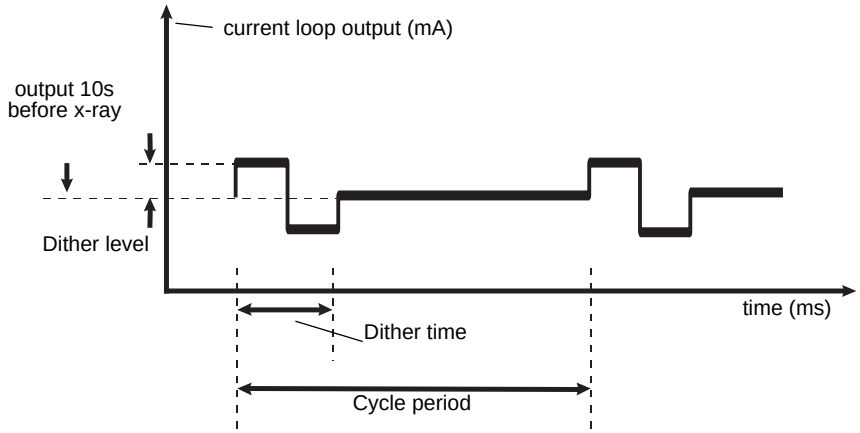
The standard x-ray alarm only triggers when the counts are greater than the Cal Low count value. These counts are found on the process variable menu. If the x-ray source is configured so the counts increase but do not exceed the Cal Low counts, the x-ray alarm does not trigger and the gauge reads the x-ray interference as a true process shift.

## Auxiliary x-ray alarm

To detect x-rays that are causing process changes, a second detector can be placed outside of the radiation beam of the primary detector. The second detector only monitors x-ray interference, and has a frequency output that wires to the auxiliary input of the primary detector.

The primary detector's programming triggers the x-ray alarm when the counts of the secondary detector are above a threshold.

Call VEGA for more information.

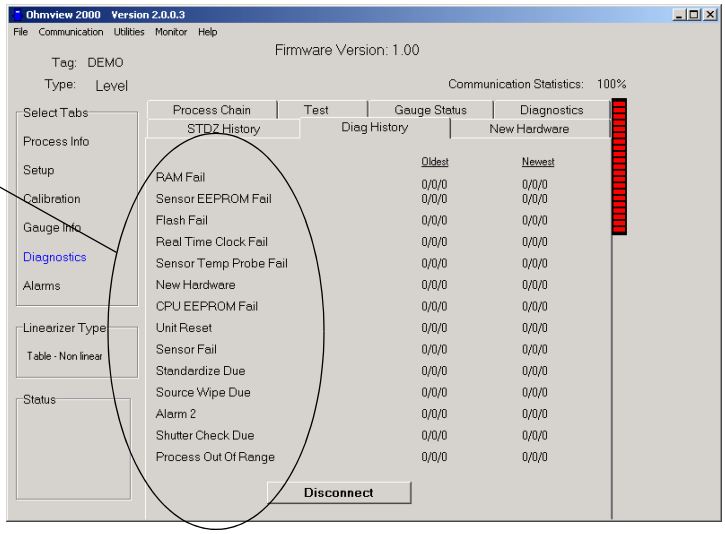



**X-ray interference alarm output**

# History information

## Diag History tab

You can view the newest and oldest trigger records for these events:




The **Diagnostics | Diag History** tab displays information about critical events.

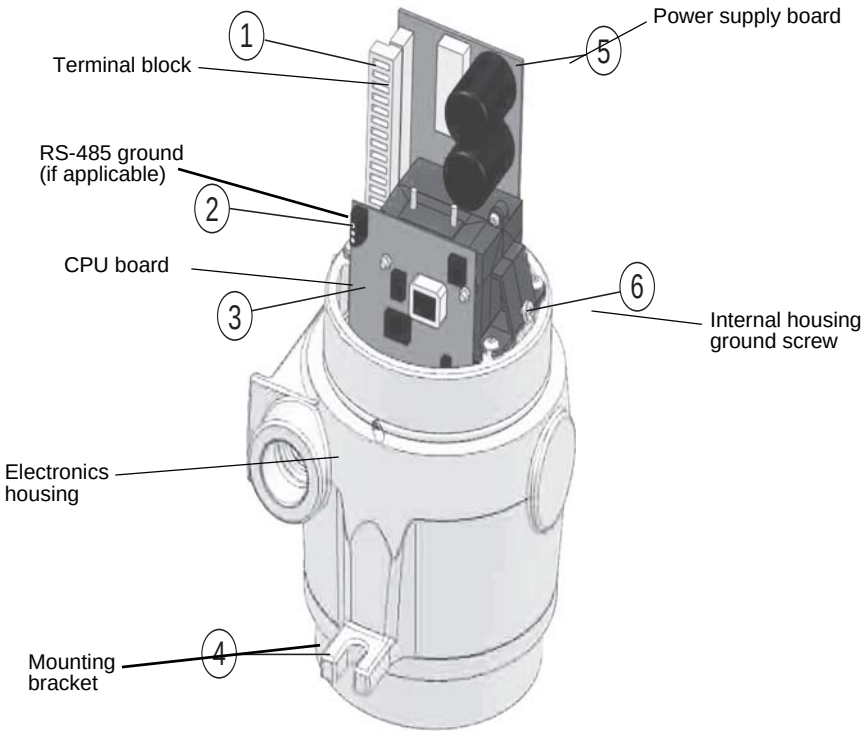
Use this information to determine whether a problem recently occurred and was internally repaired (example: EEPROM corruption).

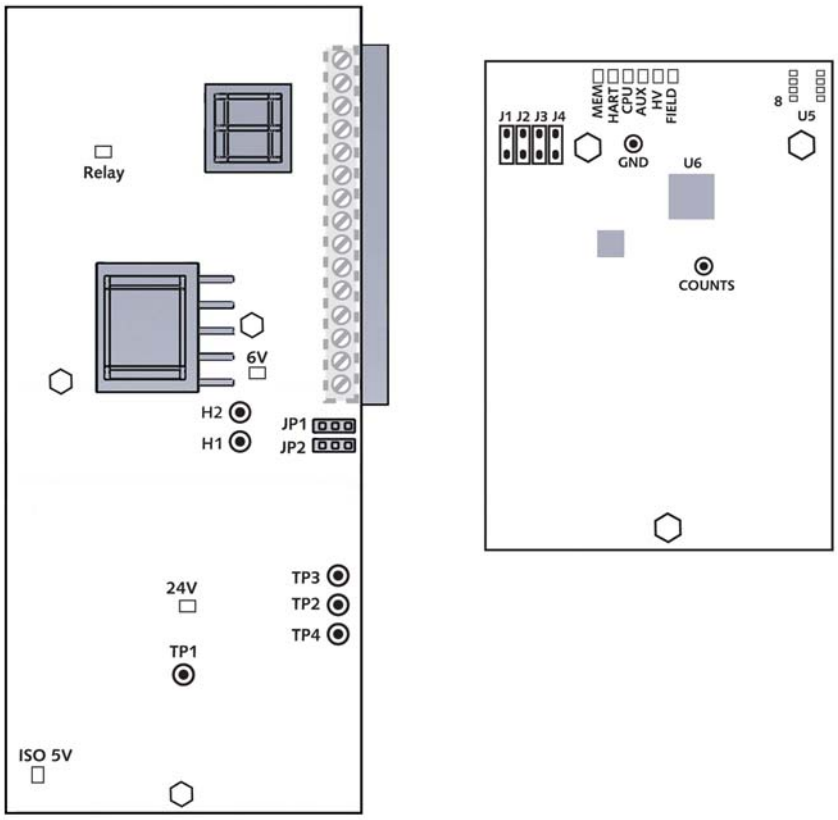
# Troubleshooting

Two circuit boards in the density gauge are field-replaceable.

***Caution:*** *A minimum of 10 minutes should be allowed after de-energizing, before opening the Gen2000 for internal inspection to permit cooling and full capacitor discharge.*

## Circuit board identifications






Power Supply and CPU Boards

## Test points

Located on the power supply and CPU board.

**Table 5.4** Power supply board test point labels

| Label | Description |
|---|---|
| H1 | HART connection |
| H2 | HART connection |
| TP1 | Isolated ground |
| TP2 | Loop current test point 200 mV/mA loop current. Referenced to isolated ground. |

**Table 5.5** CPU test point labels

| Label | Description |
|---|---|
| Count | Raw input signal coming from the preamplifier. |
| GND | Logic ground |
| U5 pin 8 | +5 V power supply test points. Referenced to logic ground. |

## Jumpers

Jumpers JP1 and JP2 on the power supply board set the current loop source or sink mode.

**Note:** Do not change the jumpers from the current setting without calling VEGA Field Service.

**Table 5.6** Jumper settings

| Mode | Gauge current loop | Jumper setting |
|---|---|---|
| Source mode | Self-powered | JP1 1-2, JP2 2-3 |
| Sink mode | DCS-powered | JP1 2-3, JP2 1-2 |

The gauge does not use jumpers J1 – J4 on the CPU board.

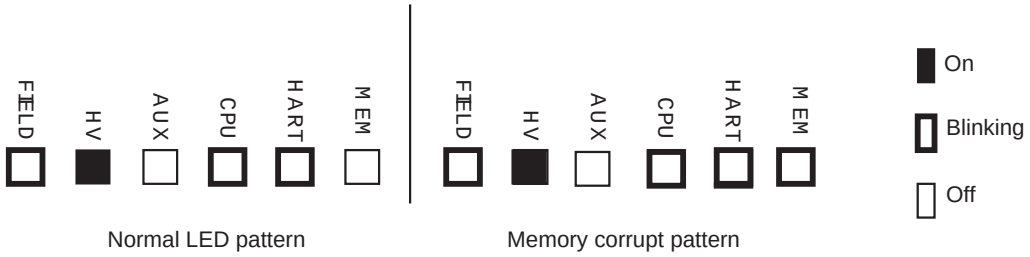
## LED indicators

**Table 5.7** Power supply board LEDs

| LED | Description | Normal Condition | Error condition | Recommendation |
|---|---|---|---|---|
| +6 V | +6 V DC voltage level to electronics | ON | OFF – electronics are not receiving +6 V DC voltage required for functioning. | Verify +6 V on test points. Check fuse on power supply board. Check power input terminals 1, 2. |
| +24 V | Analog output loop voltage | ON | OFF – 24 V not present on 4 mA ... 20 mA output.<br>4 mA ... 20 mA output and HART communications are bad. | Check loop wiring and jumpers JP1, JP2 on power supply board. Replace power supply board. |
| Relay | Relay condition indicator | ON = relay is energized.<br>OFF = relay is de-energized. | None | Check against relay output terminals 3, 4, and 5. If no relay output, replace power supply board. |

## CPU board LEDs

Use the LED indicators on the CPU board to check the basic functioning of the gauge. They are visible when you remove the explosion-proof housing pipe cap.




**Note:** If the LED band displays this pattern, call VEGA Field Service to report this condition.The gauge does not operate if the FLASH chip is corrupt.

**Table 5.8** CPU board LED summary

| LED | Description | Normal condition | Error condition | Recommendation |
|---|---|---|---|---|
| Mem | Memory corruption (EEPROMs and FLASH) | OFF | 1 blink: CPU EEPROM corrupt<br>2 blinks: Sensor EEPROM corrupt<br>3 blinks: Both EEPROMs corrupt<br>4 blinks: RAM corrupt<br>5 blinks: Memory mismatch<br>ON solid: combination of errors | Check software diagnostics. Call VEGA Field Service. |
| HART | HART communication indicator | ON – blinks when receiving HART messages | None | Check HART device connection on loop and HART device functioning. |
| CPU | Central processing unit on CPU board | Blinks at rate of 1 time per second | LED does not blink. CPU not functioning. | Check power input. Replace CPU board. |
| Aux | Auxiliary input frequency signal indicator | Blinks if auxiliary input present. OFF if no auxiliary input present | None | Check auxiliary input wiring terminals 11 and 12 with a meter for frequency signal.<br>Check auxiliary input equipment. |

**Table 5.8** CPU board LED summary

| LED | Description | Normal condition | Error condition | Recommendation |
|---|---|---|---|---|
| HV | Sensor high voltage | ON – high voltage is within specification | OFF – high voltage is outside of specification | Call VEGA Field Service |
| Field | Radiation field indicator | Cycles in proportion to radiation field intensity at detector. ON for 10 seconds for each mR/hr, then off for 2 seconds.<br>(Can use LED 5 that blinks 1 time/sec to time LED1 for field indicator.) | None | Check for closed source shutter, buildup, and insulation. |

# Maintenance and repair

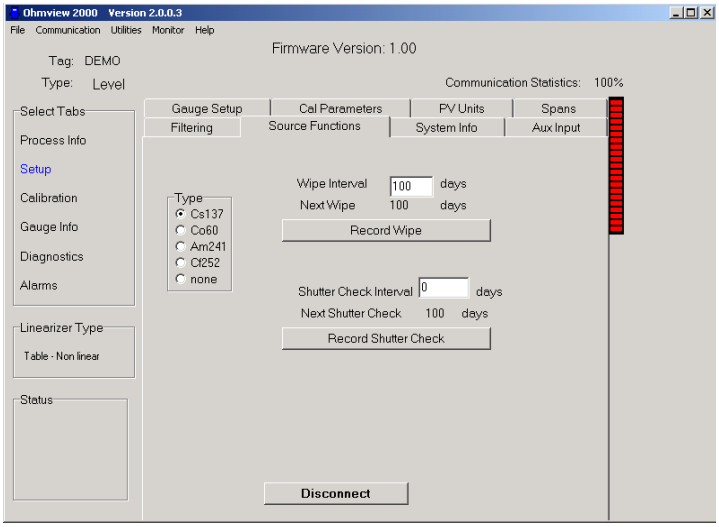
## Periodic maintenance schedule

Since the VEGA gauge contains no moving parts, very little periodic maintenance is required. We suggest this schedule to prevent problems and comply with radiation regulations:

**Table 5.9** Periodic maintenance schedule

| Description | Frequency | Procedure |
|---|---|---|
| Standardize | As required by process conditions, usually at least once a month | Calibration chapter |
| Source holder shutter check | Every 6 months unless otherwise required by the appropriate nuclear regulatory body | Radiation safety instructions shipped separately with source holder and following instructions |
| Source wipe | Every 3 years unless otherwise required by the appropriate nuclear regulatory body | Radiation safety instructions shipped separately with source holder and following instructions |

### Source Functions




## Recording the source wipe and shutter check

You can use the gauge's diagnostic alarms to remind you when a source wipe and shutter check are due. If you do, you must record the source wipes and shutter checks in the software to acknowledge the alarm and reset the timer.

Perform this procedure after a source wipe or a shutter check.

**Note:** See the Radiation Safety for U.S. General and Specific Licensees, Canadian and International Users Manual and the Radiation Safety Manual Addendum of Reference Information CD that came with the source holder and the appropriate current regulations for details.

### *Procedure 5.1: To record a source wipe or shutter check*

1. Select **Setup | Source Functions**.
2. Click **Record Wipe** or **Record Shutter Check**.

### *Procedure 5.2: To change the due date of source wipe or shutter check*

1. Select **Setup | Source functions**.
2. Change the number of days in the **Wipe Interval** or **Shutter Check Interval** field.
3. Click **OK**.

# Field repair procedures

Very few parts are field repairable, but you can replace entire assemblies or boards. These parts are replaceable:

- CPU circuit board
- Power supply circuit board

**Note:** Use great care to prevent damage to the electrical components of the gauge. VEGA recommends appropriate electrostatic discharge procedures.

## Spare parts

Contact VEGA Field Service at +1 513-272-0131 for parts, service, and repairs.

Outside the U.S., contact your local VEGA representative for parts, service, and repairs.

## Replacing the CPU or power supply board

You may have to replace a circuit board if there is damage to one of its components. Before replacing a circuit board, check the troubleshooting flowcharts or call VEGA Field Service to be sure a replacement is necessary.

The sensor EEPROM contains a backup of the CPU board EEPROM. After replacing the CPU board, you must perform a memory backup to update the CPU board's EEPROM with the information in the sensor board EEPROM.

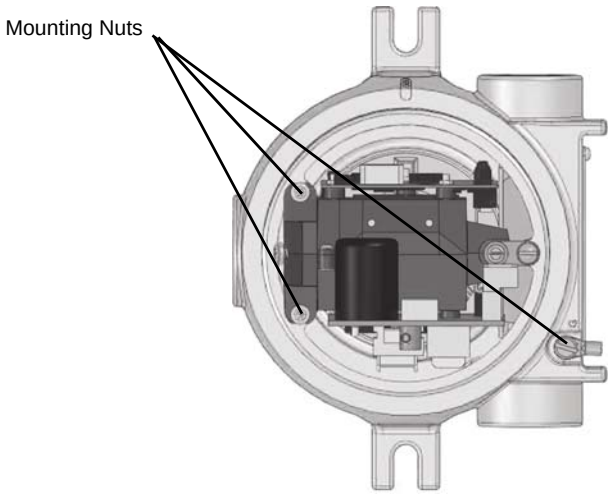
***Procedure 5.3: To replace the CPU or power supply board***

1. Shut off the power to the gauge.
2. Remove the housing cover.
3. Remove the plastic electronics cover.
4. Remove the terminal wiring connector.
5. Remove the three (3) screws holding the electronics package in place.
6. Carefully pull the electronics package out of the housing.
7. Remove the appropriate board from the clamshell assembly by removing the three (3) mounting nuts.

**Note:** If you are changing the CPU board, you must move the old firmware chip to the new board if the new board firmware is different.

8. Carefully reconnect any ribbon cables.
9. Install the electronics package in the housing.
10. Replace the three (3) mounting nuts.
11. Reconnect the terminal wiring connector.
12. Install the plastic electronics cover.
13. Install the housing cover.
14. Turn on the power to the unit.
15. Connect a HART communicator to the unit and verify that the unit is operational.

**Note:** If you change the CPU board, a New Hardware Found error message appears when you connect with the HART communicator. This is normal. Follow the procedure on page 4-6 for installing new hardware so the non-volatile memory on the CPU configures properly.




Replace Power Supply or CPU Board

# Requesting field service

Contact OVEGA Field Service at +1 513-272-0131 for parts, service, and repairs.

# Returning equipment for repair to VEGA

Have this information ready:

- ☑ Product model that is being returned for repair
- ☑ Description of the problem
- ☑ VEGA Customer Order (C.O.) Number
- ☑ Purchase order number for the repair service
- ☑ Shipping address
- ☑ Billing address
- ☑ Date needed
- ☑ Method of shipment
- ☑ Tax information

### *Procedure 5.4: To return equipment for repair*

1. Contact your local Vega representative, using the information on above, and ask for repair service.
2. VEGA assigns the job a material return authorization (MRA) number.

**Note:** You must first contact VEGA and receive a material return authorization number (MRA) before returning any equipment. VEGA reserves the right to refuse any shipment not marked with the MRA number.

3. Indicate the MRA on the repair service purchase order.
4. Clearly mark the shipping package with the MRA number.
5. Send the confirming purchase order and the equipment to VEGA's Repair Department (in U.S.) or your local representative (outside the U.S.). See page 1-11 for contact information.

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